



## Complete Summary

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### GUIDELINE TITLE

ACR Appropriateness Criteria™ for neuroendocrine imaging.

### BIBLIOGRAPHIC SOURCE(S)

Seidenwurm D, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Johnson BA, Masaryk T, Pomeranz SJ, Tanenbaum L, Masdeu JC. Neuroendocrine imaging. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl): 563-71. [36 references]

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## SCOPE

### DISEASE/CONDITION(S)

Endocrine disorders

### GUIDELINE CATEGORY

Diagnosis

### CLINICAL SPECIALTY

Endocrinology  
Family Practice  
Internal Medicine  
Neurological Surgery  
Neurology  
Pediatrics  
Radiology  
Surgery

## INTENDED USERS

Health Plans  
Hospitals  
Managed Care Organizations  
Physicians  
Utilization Management

## GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for endocrine disorders

## TARGET POPULATION

Patients with endocrine disorders

## INTERVENTIONS AND PRACTICES CONSIDERED

1. Sella x-ray
2. X-ray tomography
3. Magnetic resonance imaging:
  - Without contrast
  - With contrast
4. Magnetic resonance angiography
5. Computed tomography:
  - Without contrast
  - With contrast
6. Catheter angiography
7. Venous sampling

## MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

## METHODOLOGY

### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

### DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

### NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

#### METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Delphi Method)  
Weighting According to a Rating Scheme (Scheme Not Given)

#### RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

#### METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

#### DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

#### METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

#### DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible.

#### RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

## COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

## METHOD OF GUIDELINE VALIDATION

Internal Peer Review

## DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

## RECOMMENDATIONS

### MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria™

Clinical Condition: Neuroendocrine Imaging

Variant 1: Panhypopituitarism.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Magnetic resonance angiography	4	Indicated if better visualization of carotid arteries needed.
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
Venous sampling	2	

Appropriateness Criteria Scale

1 2 3 4 5 6 7 8 9

1=Least appropriate 9=Most appropriate

Clinical Condition: Neuroendocrine Imaging

Variant 2: Obesity/eating disorder.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	5	In selected patients with high clinical likelihood of structural abnormality.
Magnetic resonance imaging with contrast	5	In selected patients with high clinical likelihood of structural abnormality.
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated. In selected patients with high clinical likelihood of structural abnormality.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated. In selected patients with high clinical likelihood of structural abnormality.
Magnetic resonance angiography	2	
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
Venous sampling	2	

Appropriateness Criteria Scale

1 2 3 4 5 6 7 8 9

1=Least appropriate 9=Most appropriate

Clinical Condition: Neuroendocrine Imaging

Variant 3: Hyperthyroidism [high thyroid stimulating hormone].

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Magnetic resonance angiography	2	
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
Venous sampling	3	
<p style="text-align: center;"><u>Appropriateness Criteria Scale</u></p> <p style="text-align: center;">1 2 3 4 5 6 7 8 9</p> <p style="text-align: center;">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Neuroendocrine Imaging

Variant 4: Cushing's syndrome [high adrenal corticotrophic hormone].

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Computed tomography	4	Indicated if magnetic resonance

without contrast		imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Venous sampling	4	Indicated if magnetic resonance imaging is negative or equivocal.
Magnetic resonance angiography	3	Indicated if better visualization of carotid arteries needed.
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1 =Least appropriate 9=Most appropriate</p>		

Clinical Condition: Neuroendocrine Imaging

Variant 5: Hyperprolactinemia.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Magnetic resonance angiography	4	Indicated if better visualization of carotid arteries needed.
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Sella x-ray	2	
X-ray tomography	2	

Catheter angiogram	2	
Venous sampling	2	Indicated in unusual cases in which lateralization is indeterminate.
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Neuroendocrine Imaging

Variant 6: Acromegaly/gigantism.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Magnetic resonance angiography	4	Indicated if better visualization of carotid arteries needed.
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Venous sampling	3	Indicated in unusual cases in which lateralization is indeterminate.
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		



Clinical Condition: Neuroendocrine Imaging

Variant 7: Dwarfism (proportionate).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	7	
Magnetic resonance imaging with contrast	5	
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Magnetic resonance angiography	2	
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
Venous sampling	2	
<p style="text-align: center;"><u>Appropriateness Criteria Scale</u></p> <p style="text-align: center;">1 2 3 4 5 6 7 8 9</p> <p style="text-align: center;">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Neuroendocrine Imaging

Variant 8: Diabetes insipidus.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	6	
Magnetic resonance	4	

angiography		
Computed tomography without contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
Venous sampling	2	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Neuroendocrine Imaging

Variant 9: Pituitary apoplexy.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Computed tomography without contrast	6	
Computed tomography with contrast	4	Indicated if magnetic resonance imaging not available or contraindicated.
Magnetic resonance angiography	4	Indicated if better visualization of carotid arteries needed.
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	

Venous sampling	2	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

Clinical Condition: Neuroendocrine Imaging

Variant 1Q: Postoperative sella.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging without contrast	8	
Magnetic resonance imaging with contrast	8	
Computed tomography without contrast	4	Computed tomography may be indicated to assess bony anatomy and if magnetic resonance imaging is not available or contraindicated.
Computed tomography with contrast	4	Computed tomography may be indicated to assess bony anatomy and if magnetic resonance imaging is not available or contraindicated.
Magnetic resonance angiography	2	
Sella x-ray	2	
X-ray tomography	2	
Catheter angiogram	2	
Venous sampling	2	
<p align="center"><u>Appropriateness Criteria Scale</u></p> <p align="center">1 2 3 4 5 6 7 8 9</p> <p align="center">1=Least appropriate 9=Most appropriate</p>		

### Summary

The imaging approach to the hypothalamic pituitary axis is based upon specific endocrine testing suggested by clinical signs and symptoms. Endocrine disorders

are generally characterized by excess or deficiency of specific hormones. Hormone excess is diagnosed under conditions that would ordinarily suppress hormone secretion. Endocrine deficiencies are diagnosed on the basis of hormone measurements under conditions of stimulation. Specific clinical syndromes of hormonal disorders are determined by the physiologic role of that particular hormone.

Structural causes of obesity, anorexia, central hypo- and hyperthermia, insomnia and hypersomnia are rarely demonstrated in the hypothalamus and pituitary gland. Imaging in patients who present with these symptoms absent other specific neurological or endocrine abnormality is usually unrewarding. An exception is in children in whom the "diencephalic syndrome" of hypothalamic lesions is relatively common. Also in children, precocious puberty can result from hypothalamic lesions.

Classically, plain radiography and pluri-directional x-ray tomography had been the mainstay of sellar imaging. Computed tomography largely replaced these modalities through the seventies and eighties. More recently, magnetic resonance imaging has largely supplanted computed tomography. Other techniques that are employed for evaluation of this anatomical region are magnetic resonance angiography, direct catheter angiography and petrosal sinus sampling.

Plain radiography and pluri-directional tomography are insensitive and nonspecific imaging modalities for evaluation of sellar pathology. Pituitary microadenoma and even small pituitary macroadenomas are frequently associated with a normal sella size. The sella turcica can be enlarged when no neoplasm or significant mass is present. This is due to pulsations of cerebral spinal fluid through a developmentally dehiscent diaphragm sella or acquired dehiscence of the diaphragm sella in the empty sella syndrome. Therefore, these imaging modalities are rarely, if ever, employed productively in the evaluation of endocrine disease. One possible exception is that some surgeons may prefer visualization of the sphenoid sinus septations during the planning of transphenoidal approaches to sellar lesions. This information on the sphenoid sinus anatomy is much more reliably depicted by computed tomography.

Computed tomography revolutionized evaluation of the sella and supra-sellar region. Due to the ability of computed tomography, especially with intravenous contrast, to depict pathology within the unenlarged sella, and its ability to visualize suprasellar pathology noninvasively, this technique facilitates extremely accurate diagnosis of neuroendocrine abnormality. Pituitary microadenomas and macroadenomas are reliably detected. There is, however, difficulty at times in distinguishing the tumor from the optic chiasm, diagnosis of cavernous sinus invasion is difficult, and on occasion, cystic lesions of the supra-sellar region may be confused with normal cerebral spinal fluid. Additionally, artifact due to dental amalgam, difficulty in obtaining reliable contrast enhancement and awkward positioning for direct coronal scanning limit the utility of this imaging modality. In the hands of experienced radiologists this technique can result in excellent diagnostic accuracy though the examinations are sometimes difficult to interpret despite excellent technique.

Magnetic resonance imaging provides excellent noninvasive evaluation of the hypothalamus and pituitary gland. It is the only imaging modality that reliably

depicts the hypothalamus in a useful fashion. It depicts the anatomy of the pituitary gland, infundibulum, optic chiasm, cavernous sinuses and neighboring vascular structures accurately and noninvasively. The addition of gadolinium facilitates diagnosis of microadenoma and increases the confidence with which cavernous sinus invasion can be diagnosed or excluded. The specific bony landmarks may be difficult to demonstrate but the signal pattern of sphenoid sinus mucosa permits assessment of septa for operative planning. Visualization of vascular structures in the para-sellar region or even intra-sellar carotid artery loop or aneurysm is crucial in some cases.

Angiography is reserved for those patients in whom vascular pathology is known or suspected on the basis of clinical or radiological findings. Aneurysm is the most important vascular lesion in the para-sellar region, but these lesions rarely present as endocrine disorders. Knowledge of vascular anatomy guides surgery. Occasionally, a sellar lesion may grow to displace or encase the carotid arteries or other major intracranial vessels. Such interventional procedures as occlusion or embolization can be planned on the basis of diagnostic angiography.

Petrosal sinus venous sampling is reserved for those cases in which a definite excess of pituitary hormone is present, medical management has failed, sectional imaging is negative or equivocal and surgery is planned. When a significant discrepancy in hormone level, usually adrenal corticotrophic hormone, exists between the vessels studied, tumor localization is very accurate. Complications occur uncommonly in experienced hands.

A significant problem encountered in computed tomography and magnetic resonance imaging of the pituitary, particularly when endocrine findings suggest microadenoma, is the false-positive examination. Since the endocrine studies confirm the presence of a lesion, and first-line therapy is usually medical, false negative examinations are less problematic once chiasmatic compression has been excluded. Approximately 23% of the population may harbor small incidental nonfunctioning adenomas or cysts. It is important, therefore, that the probability of disease be high in the target population if positive magnetic resonance imaging is to be relied upon for surgical planning. Additional problems are created by variations in size of the pituitary gland which occur normally in response to physiological hormonal changes. The gland may enlarge in puberty and pregnancy and menopause. Pituitary hyperplasia in hypothyroidism may simulate a pituitary adenoma in some patients. Similar problems arise in imaging the posterior pituitary since up to 29% of normal subjects do not demonstrate a bright posterior pituitary.

#### CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

### EVIDENCE SUPPORTING THE RECOMMENDATIONS

#### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

Appropriate selection of radiologic exams for diagnosing patients with endocrine disorders.

### POTENTIAL HARMS

False-positive results in computed tomography and magnetic resonance imaging examinations of the pituitary are possible, particularly when endocrine findings suggest microadenoma.

Subgroups Most Likely to be Harmed:

Patients having computed tomography and magnetic resonance imaging examinations of their pituitary gland.

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Getting Better

### IOM DOMAIN

Effectiveness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Seidenwurm D, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Johnson BA, Masaryk T, Pomeranz SJ, Tanenbaum L, Masdeu JC. Neuroendocrine imaging. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl):563-71. [36 references]

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

### DATE RELEASED

1999

### GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

### SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

### GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Neurologic Imaging

### COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Panel Members: Thomas Masaryk, MD; Burton P. Drayer, MD; Robert E. Anderson, MD; Bruce Braffman, MD; Patricia C. Davis, MD; Michael D. F. Deck, MD; Anton N. Hasso, MD; Blake A. Johnson, MD; Stephen J. Pomeranz, MD; David Seidenwurm, MD; Lawrence Tanenbaum, MD; Joseph C. Masdeu, MD, PhD.

### FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

#### GUIDELINE STATUS

This is the current release of the guideline.

The ACR Appropriateness Criteria™ are reviewed after five years, if not sooner, depending upon introduction of new and highly significant scientific evidence. The next review date for this topic is 2004.

#### GUIDELINE AVAILABILITY

Electronic copies: Available from the [American College of Radiology \(ACR\) Web site](#).

Print copies: Available from ACR, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

#### AVAILABILITY OF COMPANION DOCUMENTS

None available

#### PATIENT RESOURCES

None available

#### NGC STATUS

This summary was completed by ECRI on July 31, 2001. The information was verified by the guideline developer as of August 24, 2001.

#### COPYRIGHT STATEMENT

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